The National Ecological Observatory Network $91,000,000

The FY 2013 Budget Request for the National Ecological Observatory Network (NEON) is $91.00 million, which represents the third year of a 6-year project and totals an estimated $433.72 million.

Appropriated and Requested Funding for the National Ecological Observatory Network

(Dollars in Millions)

Prior Years[1]	FY 2010	FY 2011	FY 2012 Estimate	FY 2013 Request	FY 2014 Estimate	FY 2015 Estimate	FY 2016 Estimate	FY 2017 Estimate	Total Project Cost
$3.00	-	$9.57	$60.30	$91.00	$98.20	$91.00	$80.66	-	$433.72

[1]Per P.L. 110-161, $4.0 million was rescinded from prior year unobligated balances.

NEON will consist of geographically distributed field and lab infrastructure networked via cybertechnology into an integrated research platform for regional to continental scale ecological research. Cutting-edge sensor networks, instrumentation, experimental infrastructure, natural history archive facilities, and remote sensing will be linked via the internet to computational, analytical, and modeling capabilities to create NEON's integrated infrastructure.

Baseline History

In 2004, the National Research Council (NRC) evaluated the original NEON design of loosely confederated observatories and recommended that it be reshaped into a single integrated platform for regional to continental scale ecological research. Congress appropriated a total of $7.0 million through the Major Research Equipment and Facilities Construction (MREFC) account for NEON in FY 2007 and FY 2008, $4.0 million of which was rescinded in FY 2008. A Preliminary Design Review (PDR) was completed in June 2009 and a Final Design Review (FDR) was completed in November 2009. Project planning continued through FY 2011 until construction began in August 2011. The FDR also included a formal construction baseline review and cost review; an additional baseline review was conducted in April 2011 prior to initiation of construction that confirmed the scope, cost, and schedule baselines.

Total Obligations for NEON

(Dollars in Millions)

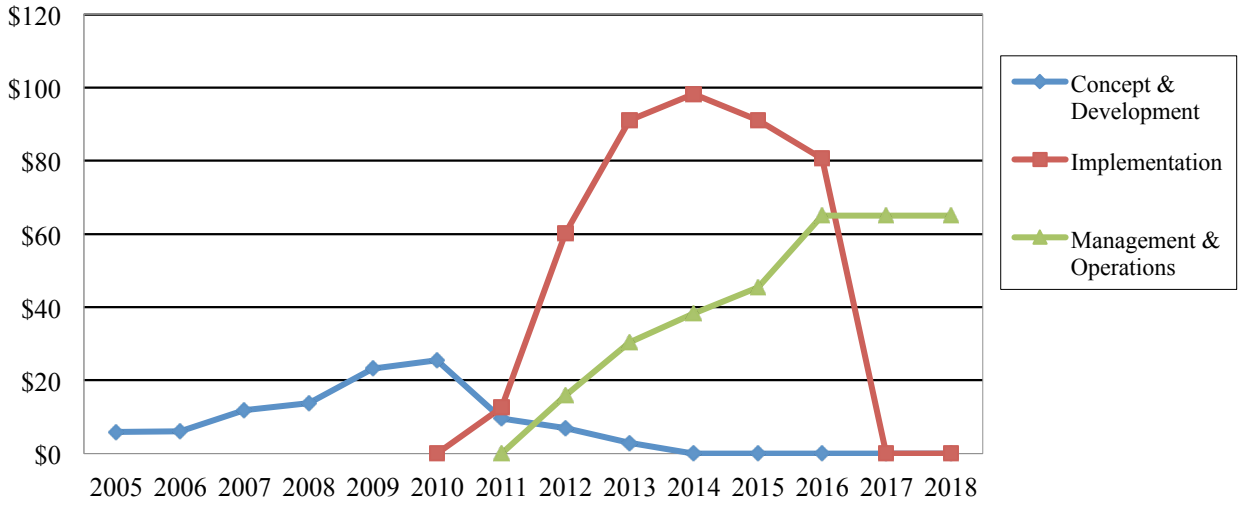
	Prior Years[1]	FY 2011 Actual	FY 2012 Estimate	FY 2013 Request	ESTIMATES FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
R&RA Obligations:									
Concept & Development	$79.15	$9.67	$7.00	$3.00	-	-	-	-	-
Management and Operations	-	-	15.93	30.39	38.18	45.51	65.00	65.00	65.00
ARRA	9.96	-	-	-	-	-	-	-	-
Subtotal, R&RA Obligations	$89.11	$9.67	$22.93	$33.39	$38.18	$45.51	$65.00	$65.00	$65.00
MREFC Obligations:									
Implementation		$12.58	$60.30	91.00	98.20	91.00	80.66	-	-
Subtotal, MREFC Obligations	-	$12.58	$60.30	$91.00	$98.20	$91.00	$80.66	-	-
TOTAL Obligations	**$89.11**	**$22.25**	**$83.23**	**$124.39**	**$136.38**	**$136.51**	**$145.66**	**$65.00**	**$65.00**

Totals may not add due to rounding.

[1] For the Prior Year column, the Concept & Development and Implementation funding lines are cumulative for all prior years.

[2] Funding for Maintenance and Operations (M&O) in outyears has been capped at now-year dollars in anticipation of an initial three year funding to test and model M&O in later years.

NEON Funding, by Stage
(Dollars in Millions)

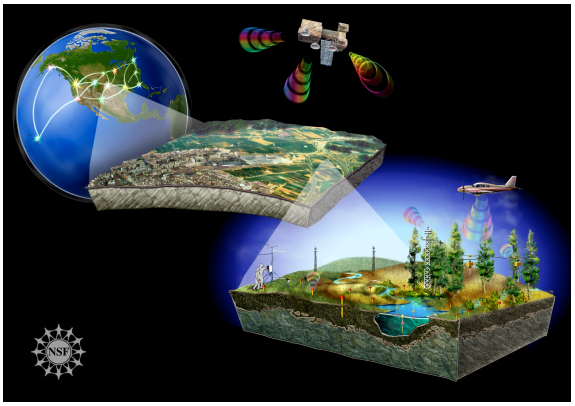


Since NSF supports 63 percent of the fundamental environmental biology research at U.S. academic institutions, advances in the field of ecology and the infrastructure to enable those advances depend largely on support from NSF. For the first time, NEON will enable scientists and researchers to address the complex phenomena driving ecological change in real time and at the scales appropriate for studying many grand challenge questions in ecology. NEON's technical and design requirements were informed by knowledge acquired from previous NSF investments in research through the Long Term Ecological Research (LTER) program, and the Ecosystem, Ecology, and Long Term Research in Environmental Biology Programs. NEON is a user facility that will enable research at regional to continental scales. NEON infrastructure will be deployed at 60 sites; eleven of them being LTER sites. When operational, NEON will allow researchers to expand the scale of their research to understand large scale dynamics affecting ecosystems. As a continent-wide research instrument, NEON will support a large and diverse group of organizations and individuals; foremost are the scientists, educators, and engineers who will use NEON infrastructure in their research and educational programs. A NEON cyberinfrastructure gateway will provide resources to support formal and informal public education and provide opportunities for citizens to participate in scientific investigations. Data from standard measurements made using NEON will be available in "near real time." The basic NEON data streams will be open-access via web portals and available as soon as possible, once basic quality assurance and quality control procedures have been applied.

Recent United States Global Change Research Program (USGCRP) assessments (Karl, Melillo, and Peterson 2009) indicate that U.S. ecosystems will experience abrupt and unpredictable changes from a suite of human-driven processes in the near future. The Administration has identified these environmental issues as among the most important, demanding, and urgent global problems of our time, and scientific discovery and science-based decision making are critical to selecting mitigation and adaptation policies and strategies. NEON will provide an unprecedented opportunity to detect environmental signals as early as FY 2013.

NEON will enable research on the impacts of climate and land use change, water use, and invasive species on the Nation's living ecosystems at temporal and spatial scales that are relevant to human well-being. NEON will be the first research platform and the only national experimental facility specifically

designed to enable basic research in these areas. All prior basic research infrastructure was designed and deployed on an *ad hoc*, question-, mission-, or site basis. NEON's unique statistically-determined, continental-scale design, with data products, data management, and standardization will support research on the dynamics of complex coupled systems needed for modeling and understanding rates of change on regional and continental scales. No other standalone system – federal or private – can provide the scientifically validated suite of data measurements that NEON anticipates providing. For example, federal operational agencies, such as the Environmental Protection Agency (EPA), provide comprehensive, sustained, and dependable observations in real time on a broad geographic basis, similar to the observations supporting the forecasts of the National Weather Service; these observations support information needs and forecasts for resource management. In contrast, NEON will provide infrastructure to enable hypothesis-driven basic biological and ecological research, with data and high-level data products available in close to real-time. NEON scientists will develop and use the latest technologies and sensors to push the envelope of knowledge. Just as NEON researchers will benefit from access to data from federal agency networks that provide spatial and temporal coverage of the U.S., so will federal agencies benefit as the techniques, sensors and knowledge gained through NEON-enabled activities migrate from research to societal applications and inform management decisions.



NEON will be a collaborative research platform of geographically distributed infrastructure connected via the latest information technology. By combining in-situ sensing with remote sensing observations, NEON will address pressing environmental questions on regional to continental scales. *Credit: NSF.*

NSF and NEON, Inc. coordinate with other federal agencies through the NEON Federal Agency Coordinating Committee, Memoranda of Understanding (MOU), Memoranda of Agreements, and Cooperating Agency Agreements. Areas of coordination include planning, design, construction, deployment, environmental assessment, data management, geospatial data exchange, cyberinfrastructure, research, and modeling. In addition, NSF will continue to seek opportunities for new interagency and international partnerships. Examples of current partnerships include:

- Design: The Jet Propulsion Laboratory (JPL) at the National Aeronautics and Space Agency (NASA) designed and is building the hyperspectral sensor for the NEON airborne observation platform. NASA and NEON, Inc. are involved in joint instrument calibration and primary algorithm development.
- NEON infrastructure deployment sites: U.S. Department of Agriculture Forest Service, USDA Agricultural Research Service, Bureau of Land Management, Department of Energy (DOE), and National Park Service.
- Sharing of geospatial data, in-situ verification, and archival of NEON aerial remote sensing data with the U.S. Geological Survey (USGS).
- Partners in research, modeling, data exchange, standards, and protocols: NASA, the National Oceanic and Atmospheric Administration (NOAA), USGS, and EPA.
- International: Discussions between NEON, Inc. and Mexican and Canadian scientists to broaden linkages with NEON and expand the research capability to the North American continent are underway. Global partnerships with the European Union and Australia are developing.

Private organizations including the Heinz Center, National Geographic Society, Nature Serve, and the Science and Engineering Alliance, participated in NEON design and development activities. The Science

and Engineering Alliance and the Ecological Society of America are assisting NEON, Inc. with education and inclusion of minority serving institutions in NEON science and education. Building enhanced accessibility for all institutions into the design will broaden the impact of NEON science and education to the next generation of scientists and educators. While the bulk of NEON's infrastructure and instrumentation will be "commercial off-the-shelf," NEON's scientific and networking design required certain technological innovations. Consequently, the Directorate for Biological Sciences (BIO) has provided Research and Related Activities (R&RA) funds for advanced research and development (R&D) activities in the areas of sensors, cyberinfrastructure, and remote sensing technology.

Project Report

Management and Oversight

- NSF Structure: The NEON program is managed in the Directorate for Biological Sciences (BIO) Office of the Assistant Director (OAD/BIO) as part of Emerging Frontiers. OAD/BIO provides overall policy guidance and oversight, and the location of the NEON program in Emerging Frontiers (EF) within BIO fosters its broader biological and interdisciplinary science connections. The NEON program is managed by a dedicated program officer, and an NSF/NEON project manager was added in FY 2011 to oversee construction and participate in planning, development, and oversight of management and operations. A business oversight team chaired by the NEON program officer advises and assists with the business framework of the project. A BIO-NEON committee, which includes the Deputy Director for Large Facility Projects in the Office of Budget, Finance and Award Management (BFA) and a cross-NSF Program Advisory Team (PAT), formulates program planning for NEON. The NEON program officer served as the contracting officer's technical representative (COTR) for the NEON environmental assessment completed in FY 2010. A NEON Environmental Assessment Team (EA) provides ongoing technical advice on the National Environmental Policy Act (NEPA) compliance and NSF environmental policy.

- External Structure: The NEON project is funded through cooperative agreements with NEON, Inc., a non-profit, membership-governed consortium, established to oversee the design, construction, management, and operation of NEON for the scientific community. Within that organization, the CEO provides overall leadership and management; the project manager oversees all aspects of the project design, review, construction, and deployment; the chief science officer provides scientific leadership; and the director of computing is responsible for oversight of the cyberinfrastructure and embedded sensor development. A Board of Directors and a Science, Technology, and Education Advisory Committee (STEAC) composed of members of the NEON user community, each provide oversight and guidance to the project and help ensure that NEON will enable frontier research and education. A Program Advisory Committee (PAC) will be formed once the first sites are commissioned.

- Reviews:
  - Technical reviews: The NEON Observatory Design Review (including site selection and deployment design) was successfully completed in February 2009.
  - Management, Cost, and Schedule reviews:
  - The Conceptual Design Review was held in November 2006.
  - A combined PDR/FDR of the airborne observation platform was successfully completed in February 2009.
  - A PDR for the entire project was successfully completed in June 2009.
  - An FDR was successfully completed in November 2009, including construction and cost reviews.

- National Science Board (NSB) Review: The Board reviewed and authorized NEON construction subject to final appropriation of funds in May 2010.
- An additional baseline review, to ascertain readiness to begin construction, was conducted in April 2011 prior to construction.
- NSF conducted a Business Systems Review (BSR) and issued a final report in November 2011.
- An operations review of the project's operating plan and anticipated budget was held in January 2012.
- An annual construction review will be scheduled for summer 2012 and 2013.

Current Project Status

In November 2009, the final design, scope, schedule, and risk-adjusted costs were reviewed and the project's baseline scope, budget, and schedule were found to be credible. The review panel endorsed the pre-construction planning activities in 2011 that enabled the project to commence construction in FY 2011. Contingency was increased to cover known risks, per panel recommendations. The NEON, Inc. project office completed the final design and NEON project execution plan (PEP). The site selection and associated deployment plan were merit reviewed during the preliminary design review. The NEPA environmental assessment was also completed in November 2009. A "Finding of No Significant Impact" was signed by NSF in December 2009; the U.S. Fish and Wildlife Service concurred with this finding, as well as with NSF's compliance with the Endangered Species Act. In April 2010, a NEON-led operations review was completed; NSF staff participated as observers. In July 2011, the NSF Record of Decision was signed, which allowed construction to commence in August 2011. The first NSF-led operations review, covering the operating plan and associated budget, was conducted in January 2012.

In FY 2012, funding for Concept and Development is provided through BIO's Emerging Frontiers division within the R&RA account. These funds are used to used to retire risk, complete detailed construction-ready design documents, and scale up final project activities, including: the airborne spectrometer; establishment of the NEON Calibration/Validation Laboratory for sensors and instrumentation; advanced design for the first six NEON domains and all NEON core sites; and permitting for the first six domains. Funds will continue to be provided through the R&RA account for innovation and advanced development of new technologies, new capabilities, observatory improvements and performance upgrades, collaborative partnerships with PI-led experiments involving observatory infrastructure that require engineering innovation, and sensors to reduce human-mediated measurements of biology. Funds will support innovative approaches for training, education, and outreach.

Cost and Schedule

The projected length of the project is six fiscal years, with a six-month schedule contingency. The risk-adjusted cost of $433.72 million includes a contingency budget of 19 percent.

In 2011, NEON obligated $9.57 million in MREFC funds to initiate construction. These funds supported hardware and software development for cyberinfrastructure, tower boom assemblies for production, engineering technical facility, project management and systems engineering, and contracts and procurements for some long-lead instruments, communications, civil infrastructure, and field equipment.

In FY 2012, $60.30 million is provided for construction. These funds support: civil and facilities construction in four domains; instrument procurement and calibration for five domains, with deployment in three domains; biological site characterization in three domains; and aquatic site characterization in all domains. Construction activities include production engineering and ongoing equipment procurement for the associated calibration/validation and instrument integration laboratories. These funds also include support for the Data Center infrastructure and will initiate the data products application implementation.

Construction will begin on the NEON Airborne Observatory, including spectrometer and Light Detection and Ranging (LIDAR) procurements.

In FY 2013, $91.0 million from the MREFC account is requested for construction. These funds will support: continuation of civil and facility construction and instrumentation deployment in the next six domains in the construction schedule. Commissioning of the three domains constructed in FY 2012 will occur. Biological sampling and analysis activities will commence in all constructed and accepted Observatory sites. Stream Experimental and Observatory Network (STREON) site construction will begin and pre-manipulation sensing and measurements will begin. Funds will also support continuation of the NEON cyberinfrastructure hardware and software development and implementation. The Level I-III ecological data products, a key cyberinfrastructure deliverable, will be made available to the research community. The first NEON Airborne Observatory platform is expected to be completed, fully instrumented, and flight-tested in preparation for delivery to Observatory operations in FY 2014.

In FY 2013, management and operations funding will commence. $30.39 million is requested from the R&RA account for maintenance and operations of the five domains commissioned, including related management and technical support, seasonal biological sampling, and domain facilities costs. Funds will also support headquarters functions, including the Airborne Observatory and Calibration & Validation Laboratories.

Risks

Technical: Dependence on commercial off-the-shelf technology will be mitigated by long-lead purchase orders and alternative vendors. Production quality, embedded and system-level cyberinfrastructure will be addressed by a combination of "in-house" design, commercial, contracts, and targeted research (e.g., cyber-dashboard).

Deployment: Environmental assessment and permitting may impact schedule and costs. These risks have been and continue to be addressed through multiple means, including: the direct contracting of the environmental assessment by NSF; the hiring of two national firms by NEON, Inc. for engineering and permitting; the identification of alternative sites if the primary sites are determined to have significant risk; and the allocation of two full-time equivalents (FTE) by the U.S. Forest Service to assist with environmental compliance issues on Forest Service lands.

Geospatial Data Acquisition: A potential risk is the long-term availability of satellite (e.g., LANDSAT and MODIS) borne sensors. This risk is mitigated through a partnership with the USGS Earth Resources Observation and Science (EROS) Data Center, which has the federal responsibility for curation and management of LANDSAT and MODIS images and having alternative satellite sensor sources to purchase images (e.g., SPOT - France, AWIFS – India, Terra and Aqua – U.S.). The proposed NEON airborne observatory platform (AOP) sensor system design and aircraft availability are also sources of technical and implementation risk. To minimize this risk, the AOP is being developed by JPL; similar instrument packages are being prototyped by NASA and Carnegie Institution at Stanford University. The sensor system fits multiple aircraft, including commercial aircraft. Experienced flight design engineers were contracted by NEON, Inc. to provide the baseline operations plans, aircraft analysis, and assessment of commercial companies that could potentially support NEON flight operations, and experienced research aircraft pilots serve on the design team.

Future Operations Costs

NEON will be the first research observatory that will maintain and operate in-situ instrumentation and conduct biological sampling in twenty domains (106 locations); three airborne observatories; a central operating facility; and a cyberinfrastructure center. Support will be provided to monitor the sensors, and receive, process, and archive the data from all measurement systems. NEON operations include

significant labor costs due to the labor-intensive processes required for biological sampling and data collection as part of the Fundamental Sentinel Unit (FSU), which is a major component of each domain. NEON is reliant on sensors and cyberinfrastructure that have a defined lifecycle, so operations costs include scheduled replacement and refreshing of sensor, instrumentation, and cyberinfrastructure technology. Due to the complexity of operating the facility, NSF provided funds to prototype, test, simulate, and evaluate the major cost drivers.

NEON, Inc. developed an operations and maintenance plan for review that included scope, schedule, and costs for the first eight years of operations. NSF convened an operations and cost review in January 2012 to evaluate the plan, schedule, and costs. The panel concluded that the Operations and Maintenance Plan's scope, costs, schedules, staffing, and transition to operations were thorough and accurate, and that NEON has done an exemplary job of using prototyping to gain operational experience. The panel indicated that the budgetary estimates are based on the best analyses of extant information and modeling, and any improvement in efficiencies or costs will require actual operating experience. Given the high degree of complexity planned for NEON, and its large, distributed nature, it was recommended that NEON gain operations experience and explore the potential for efficiencies through a three year initial operations funding.

The current request incorporates a three year initial operations request to allow NEON to gain operational experience and explore opportunities for schedule and cost efficiencies. For the outyears the costs are held constant at the projected operations ceiling reviewed at both the Preliminary Design and Final Design Reviews. After gaining operational experience, NEON, Inc. will submit a plan for the remaining five years.